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Examining Salinity Restrictions for CO_2 Storage:

Suggestions from basin to reservoir scales.

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GWPC 2011: Carbon Capture & Storage & Groundwater

USGS U.S. Department of the Interior
U.S. Geological Survey

Outline

- *Background of the USGS National CO_2 Assessment*
- *EPA Class VI injection well TDS regulations*
- *Reservoirs with fresh and saline data*
- *The USGS basin-scale approach*
- *Suggestions for reservoir-scale approaches*

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USGS National CO_2 Assessment

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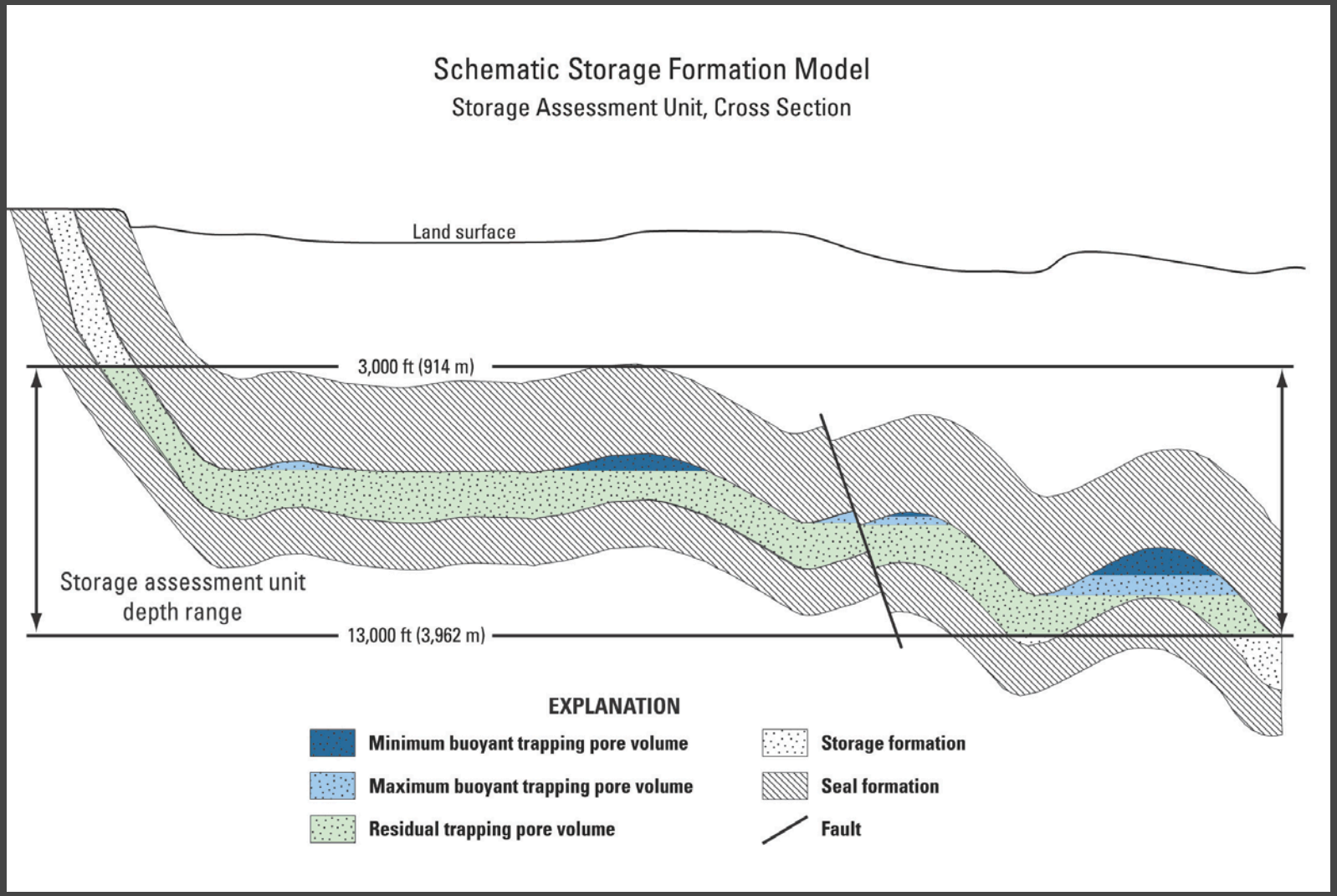
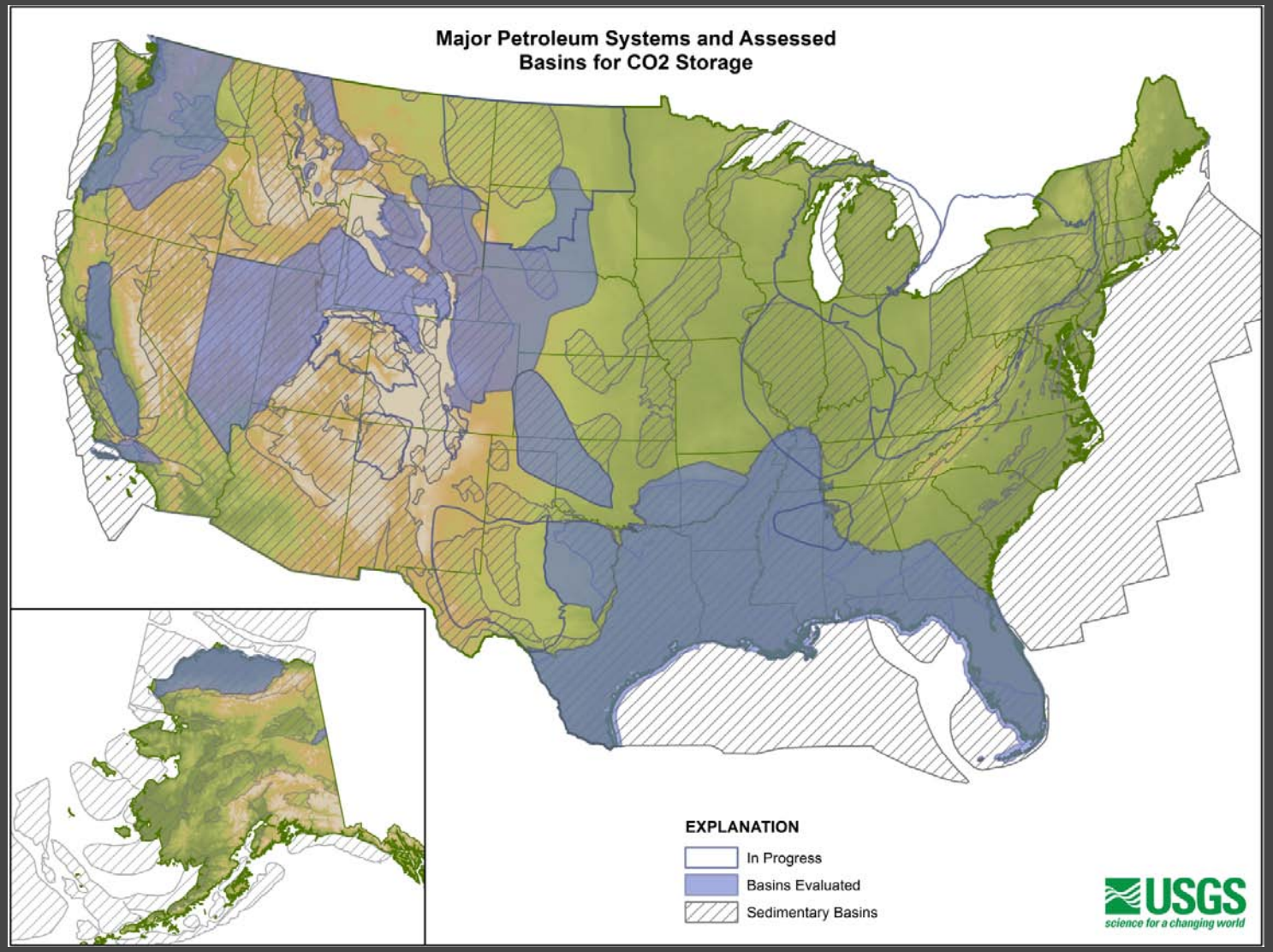
USGS CO_2 Sequestration Assessment



USGS

Brennan et al., 2010

USGS CO_2 Sequestration Assessment



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As of September 25, 2011

EPA Class VI injection well regulations

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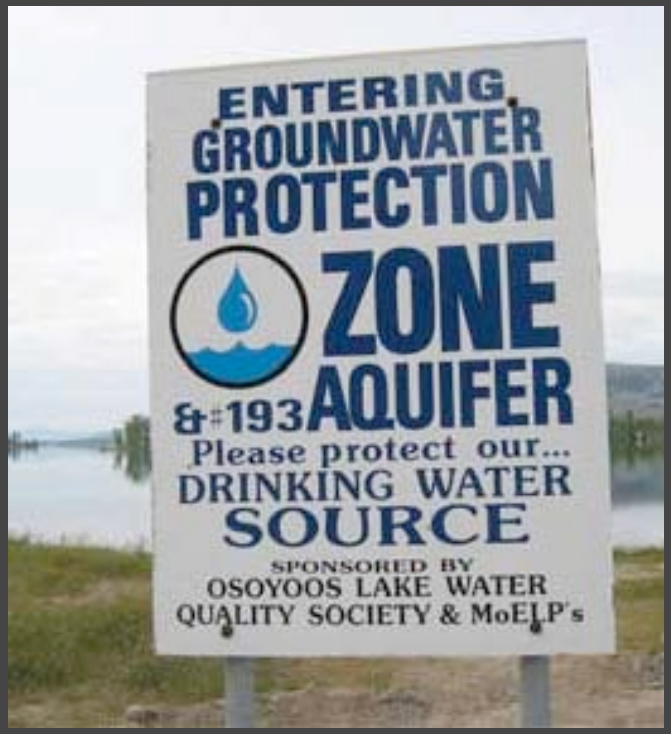
Use of Water Quality Data

- *EPA UIC program for Class VI wells prohibits injection into USDW.*
- *USDW: Total Dissolved Solids (TDS) concentration less than 10,000 mg/L.*



http://www.olwqs.org/aquifers.html

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Reservoirs with fresh & saline data

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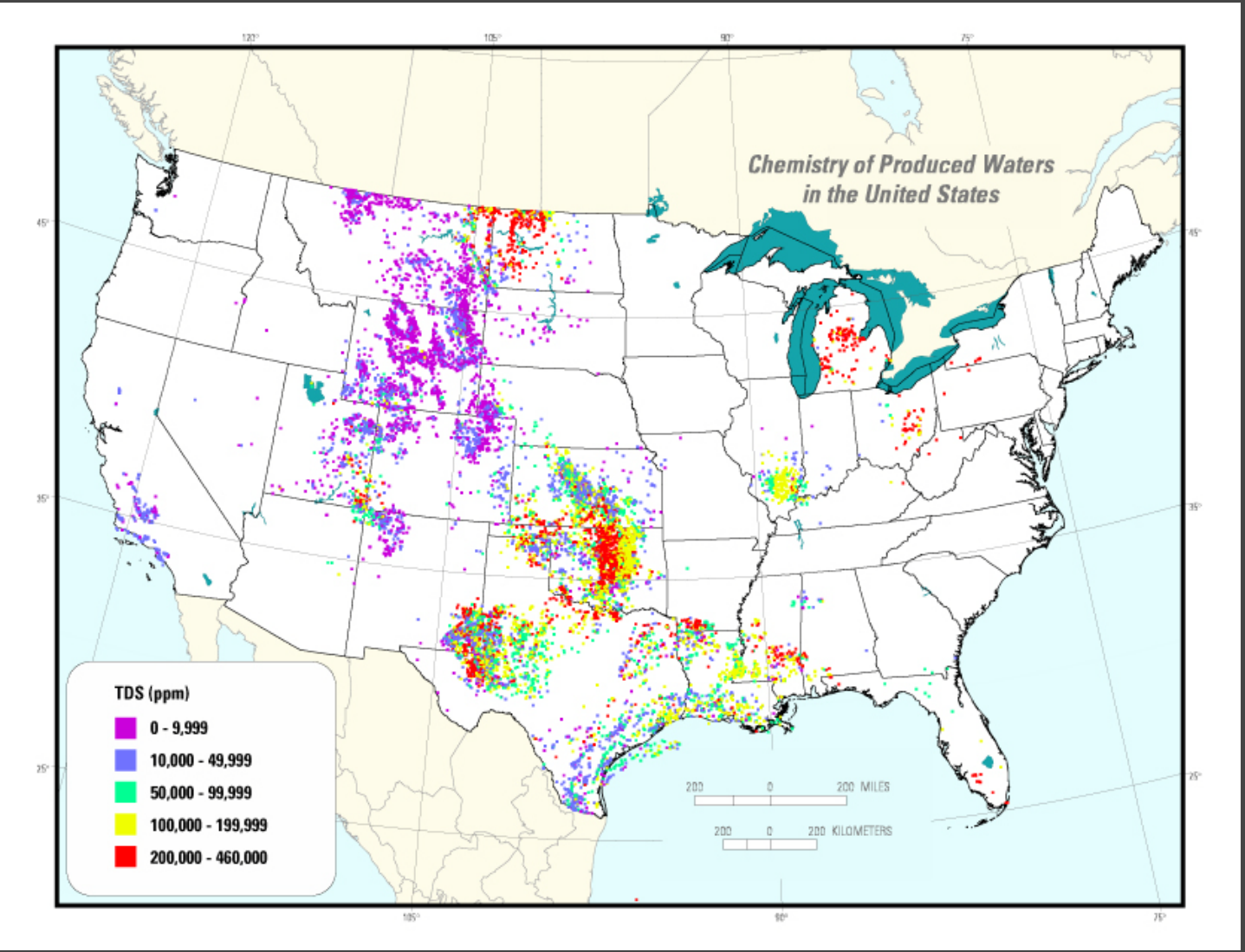
Produced Water Total Dissolved Solids



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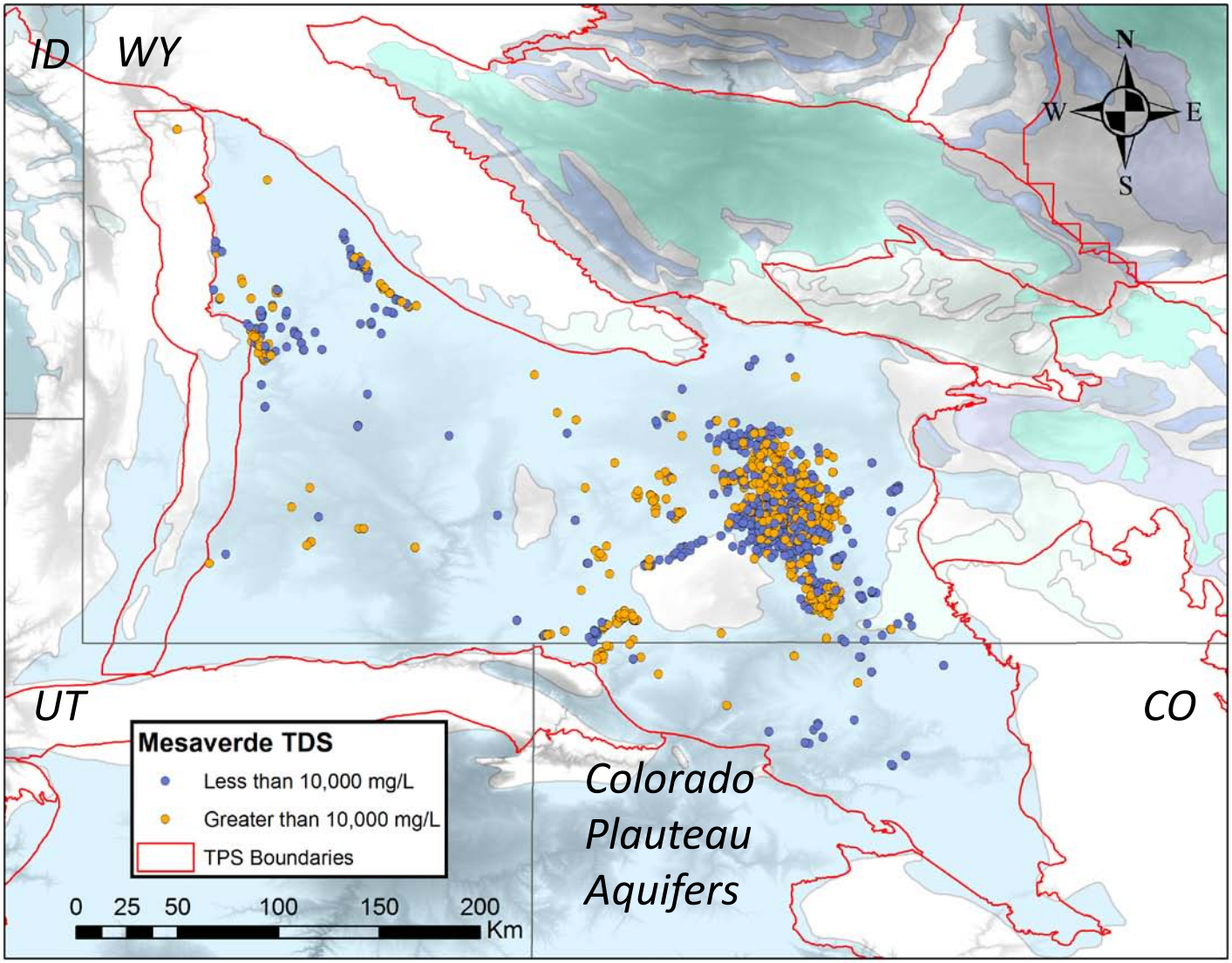
http://energy.cr.usgs.gov/prov/prodwat/uses.htm

Spatial Distribution of TDS data



Whitehead, 1996, USGS Ground Water Atlas

USDW 10,000 mg/L cut off

- *All TDS data > 10,000 mg/L?*
- *Does a single "saline" data point in an otherwise "fresh" water aquifer make injection legal?*
- *Some summary statistic (mean, mean + standard deviation, median, P90, etc.) > 10,000 mg/L?*
- *Can the cut off be determined spatially?*

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The USGS basin-scale approach

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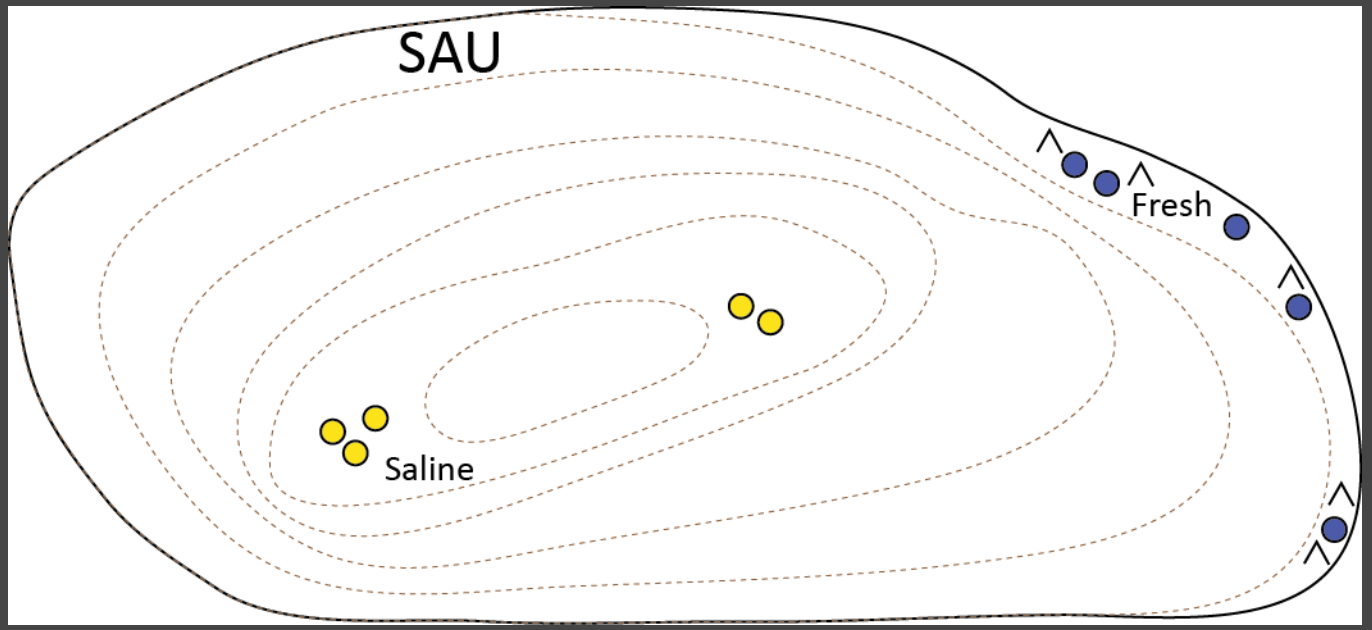
USGS CO2 Assessment Approach

- *Apply a factor (0-1) to the residual volume*
- *Probabilistic MIN / MID / MAX*



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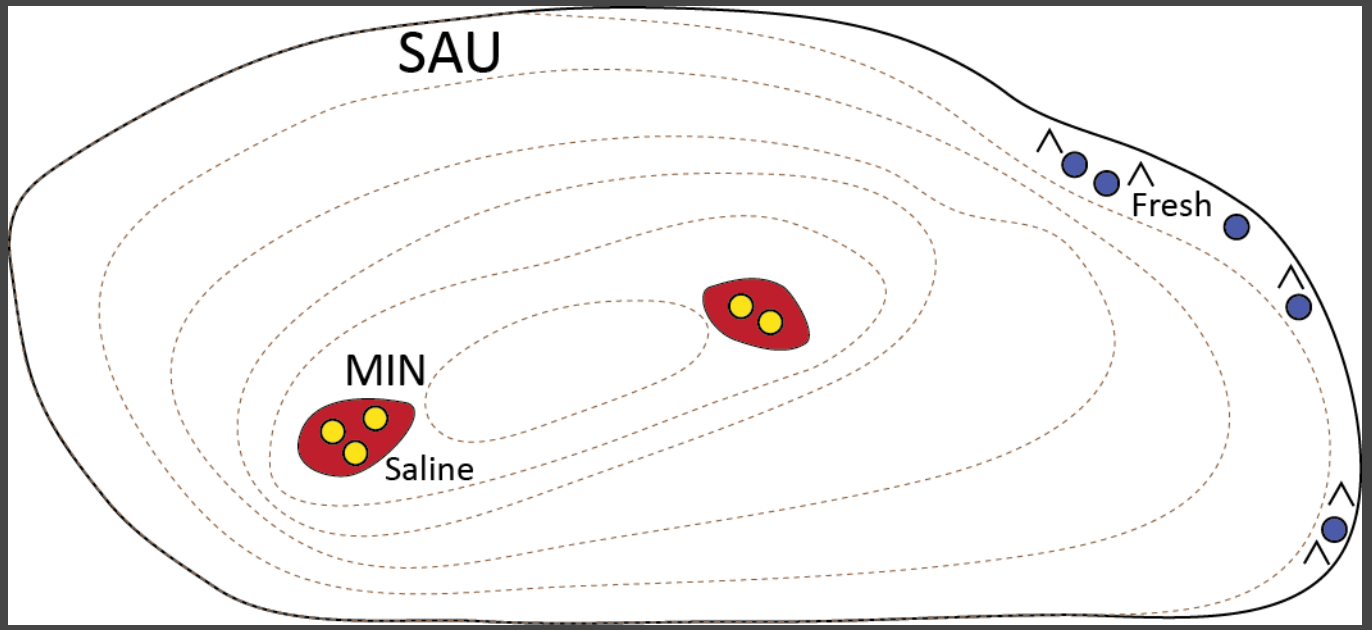

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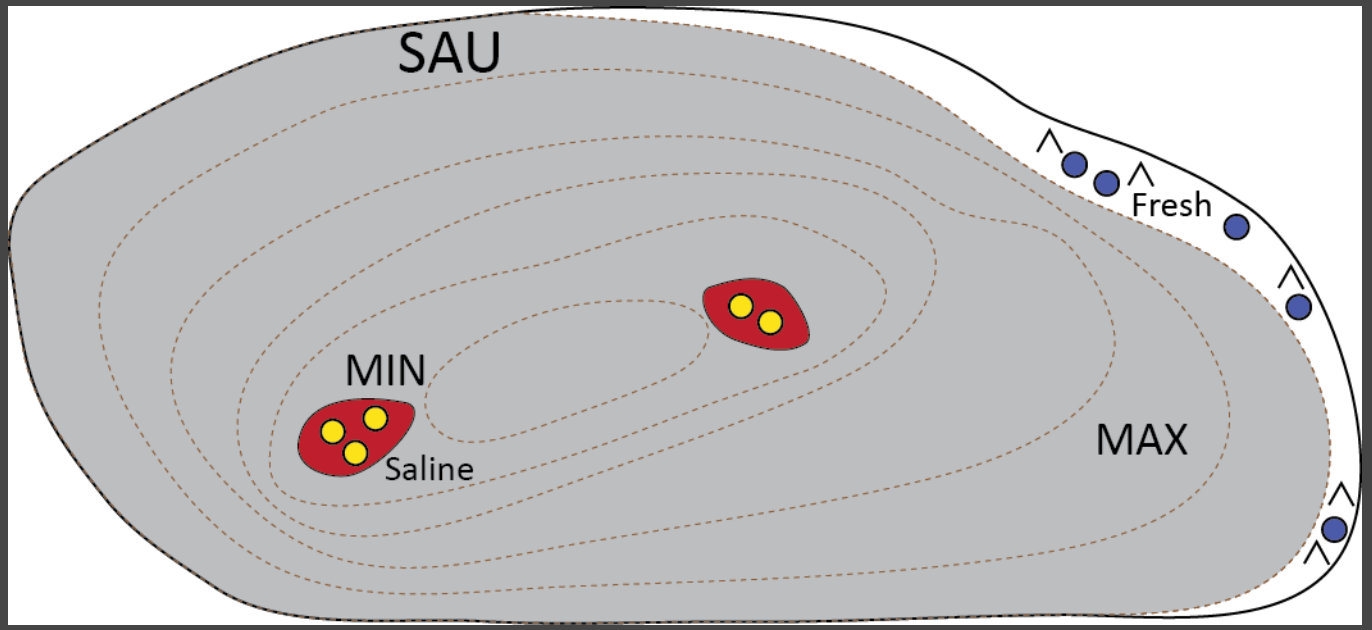

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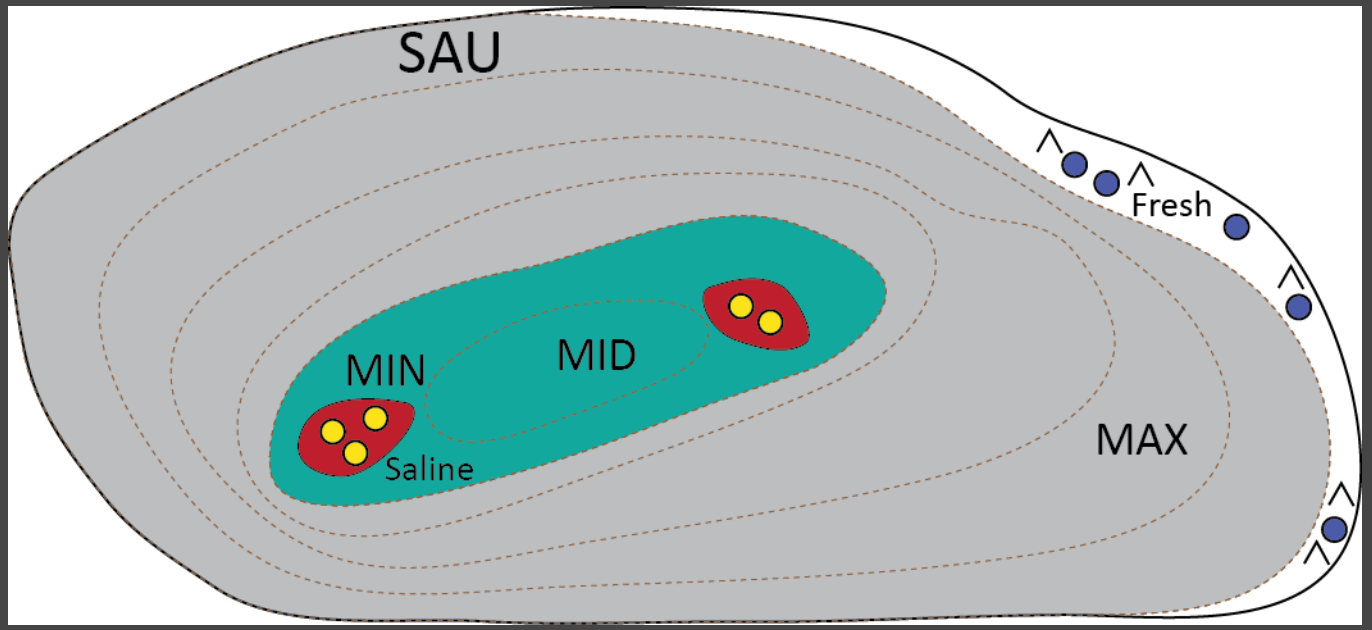

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Suggestions for reservoir-scale approaches

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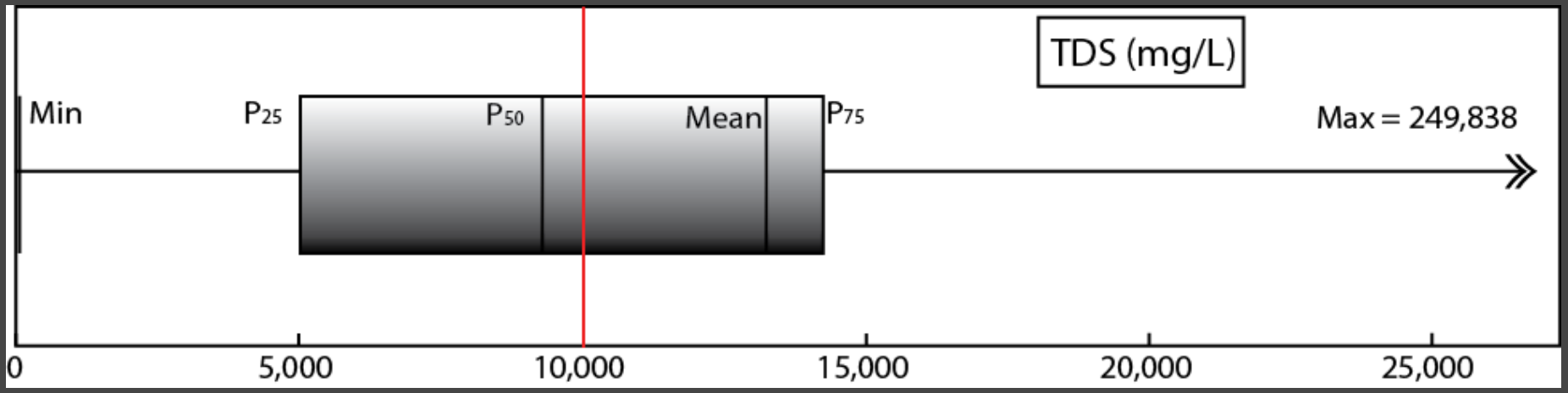
Statistical Definition – 10,000 mg/L cut-off



Mean is above 10,000 mg/L
Median is below 10,000 mg/L

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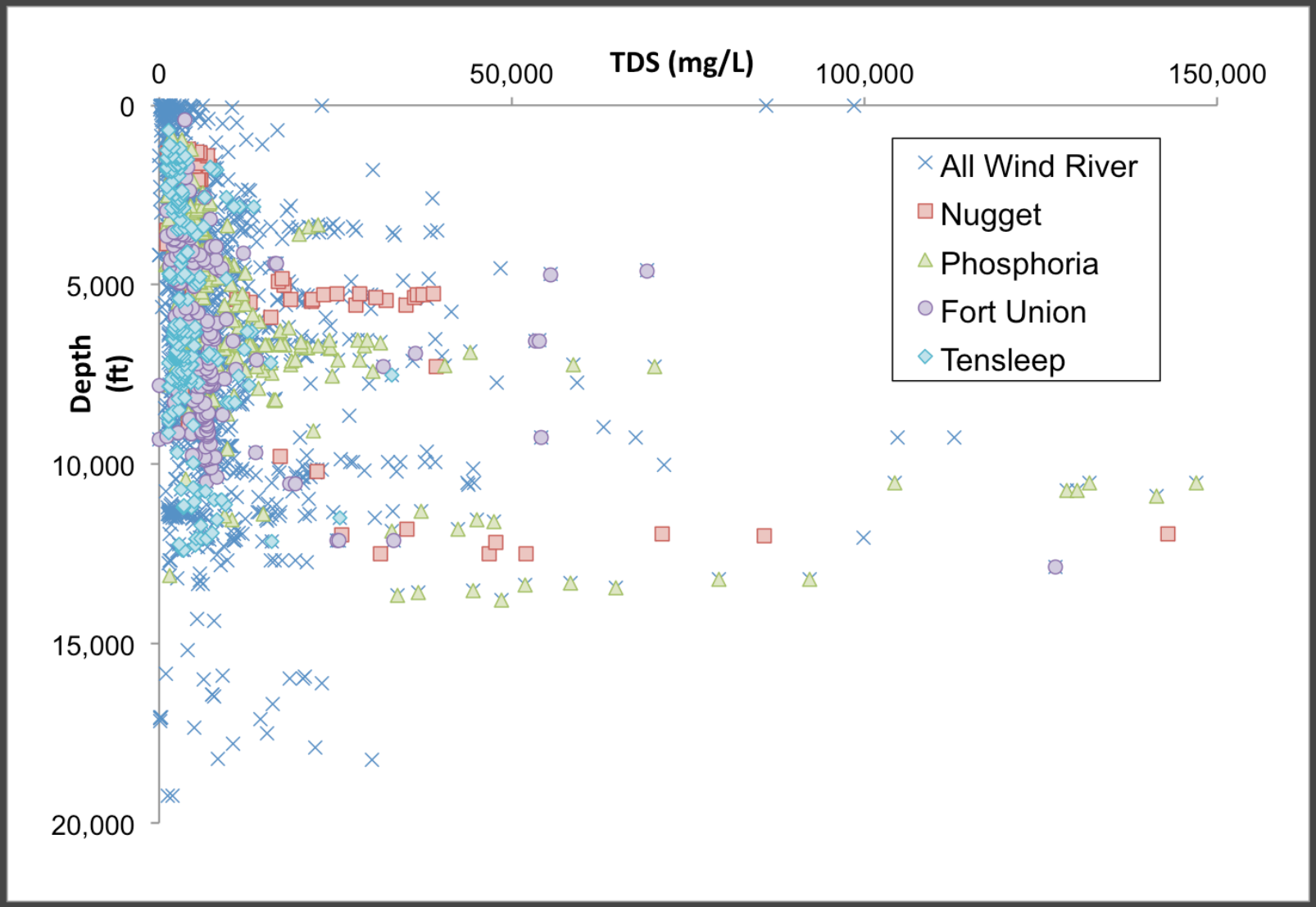
TDS vs. Depth (Wind River Basin)



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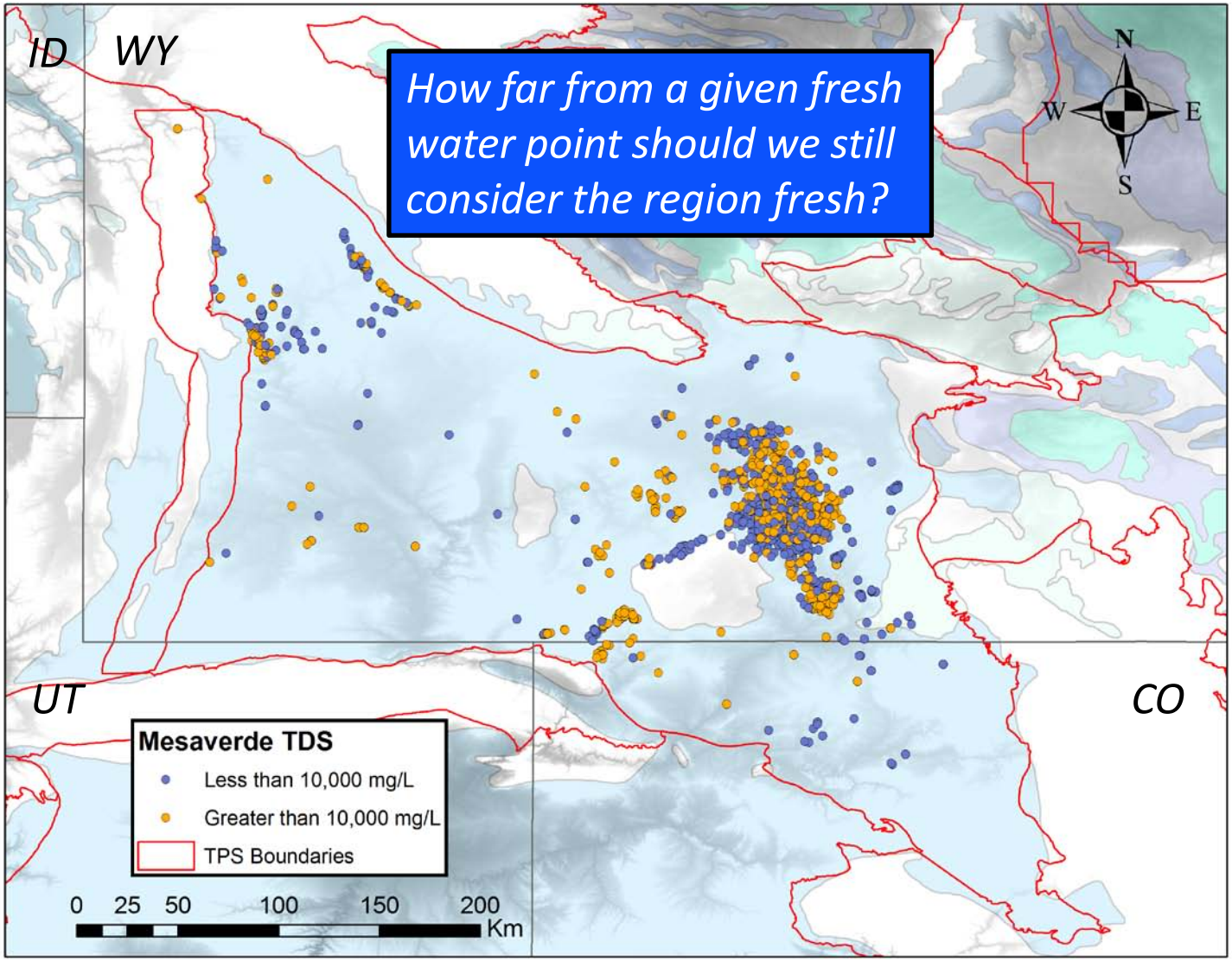
Breit (2002) USGS Produced Waters Database; Greater Green River Databases (2003); NWIS (2002); Murrell (2010) Enhanced Oil Recovery Institute; NWIS (2002); NETL Rocky Mountain Produced Waters Database; Wyoming Oil and Gas Conservation Commission (2010).

Spatial Definition – 10,000 mg/L cut off



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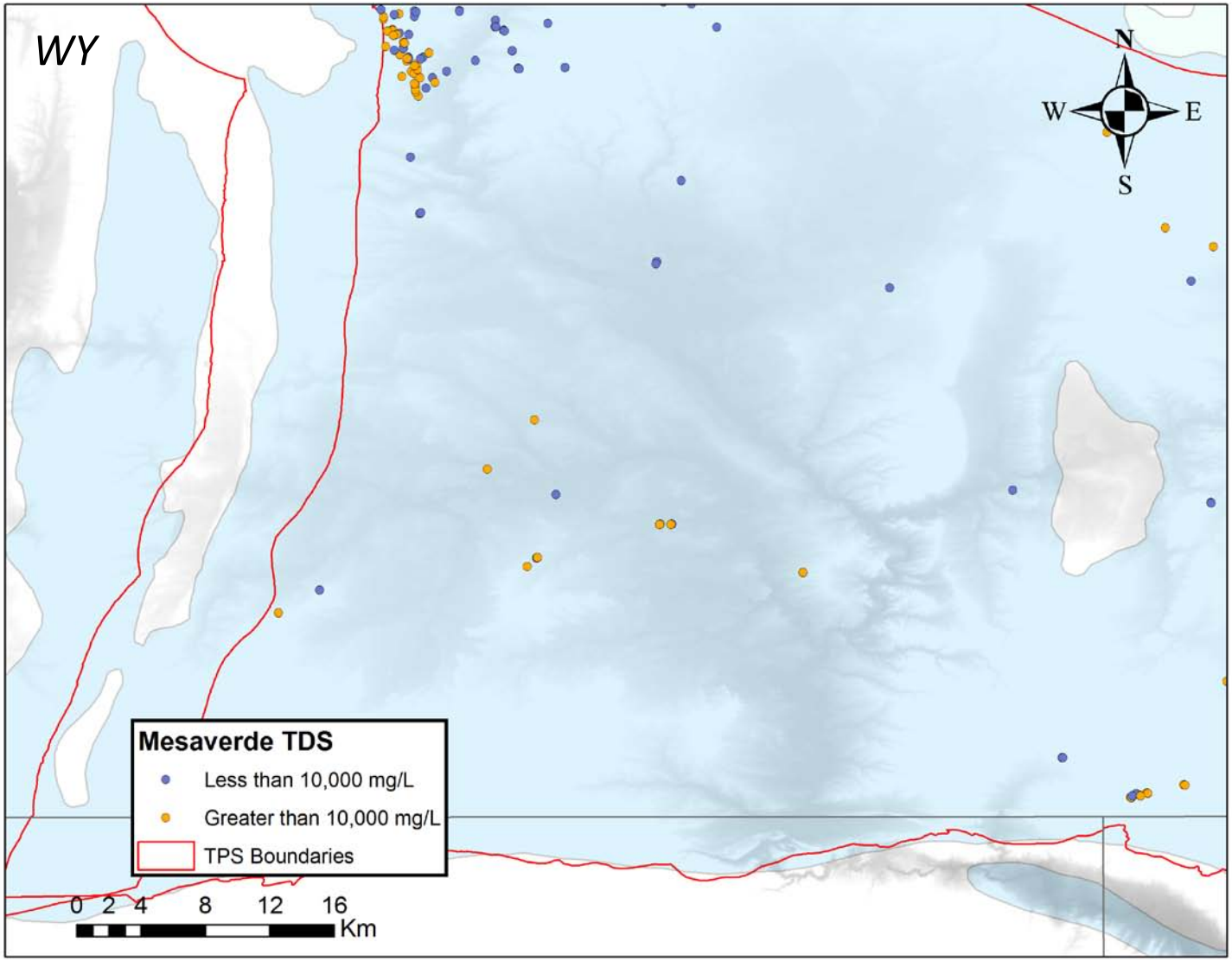

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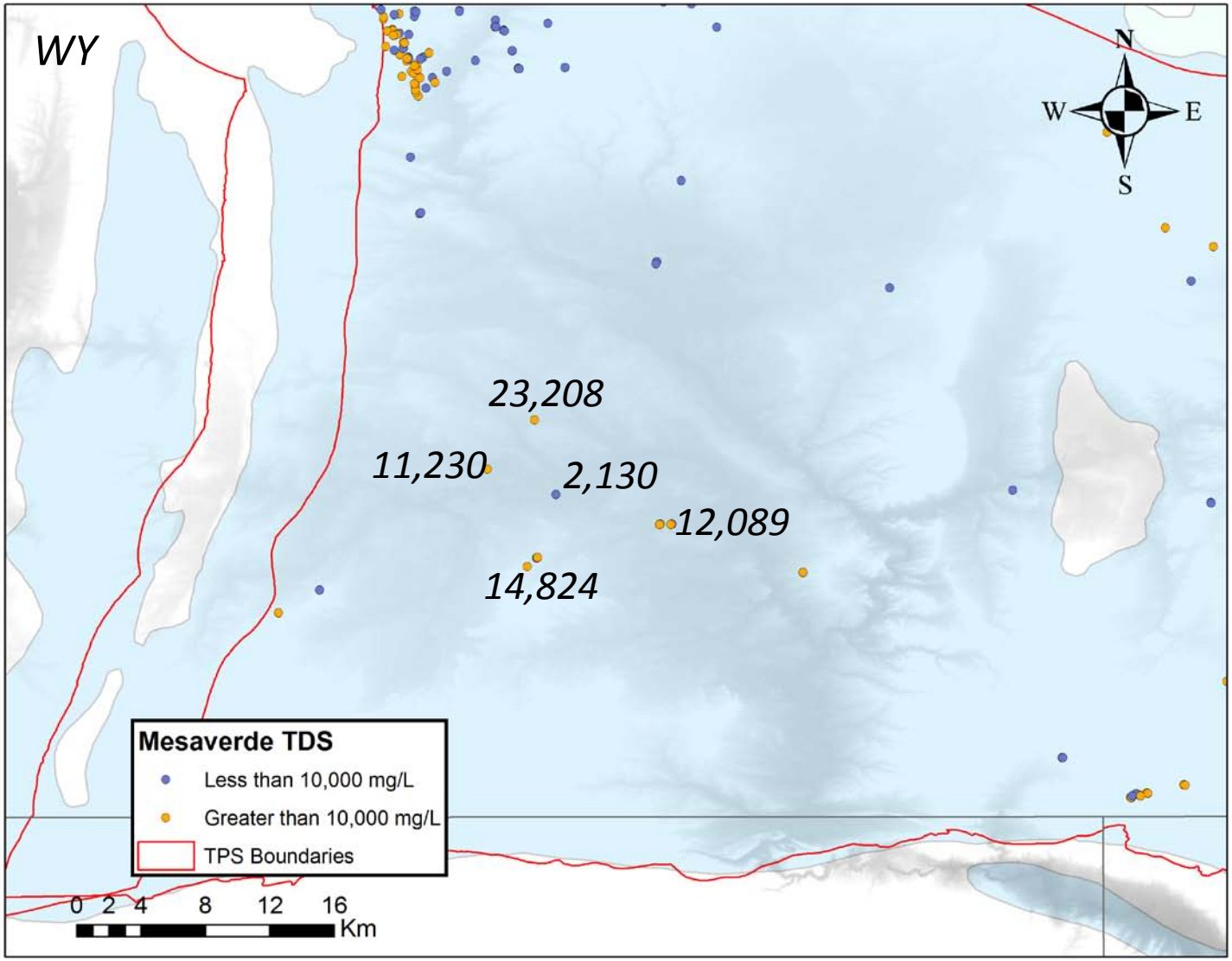

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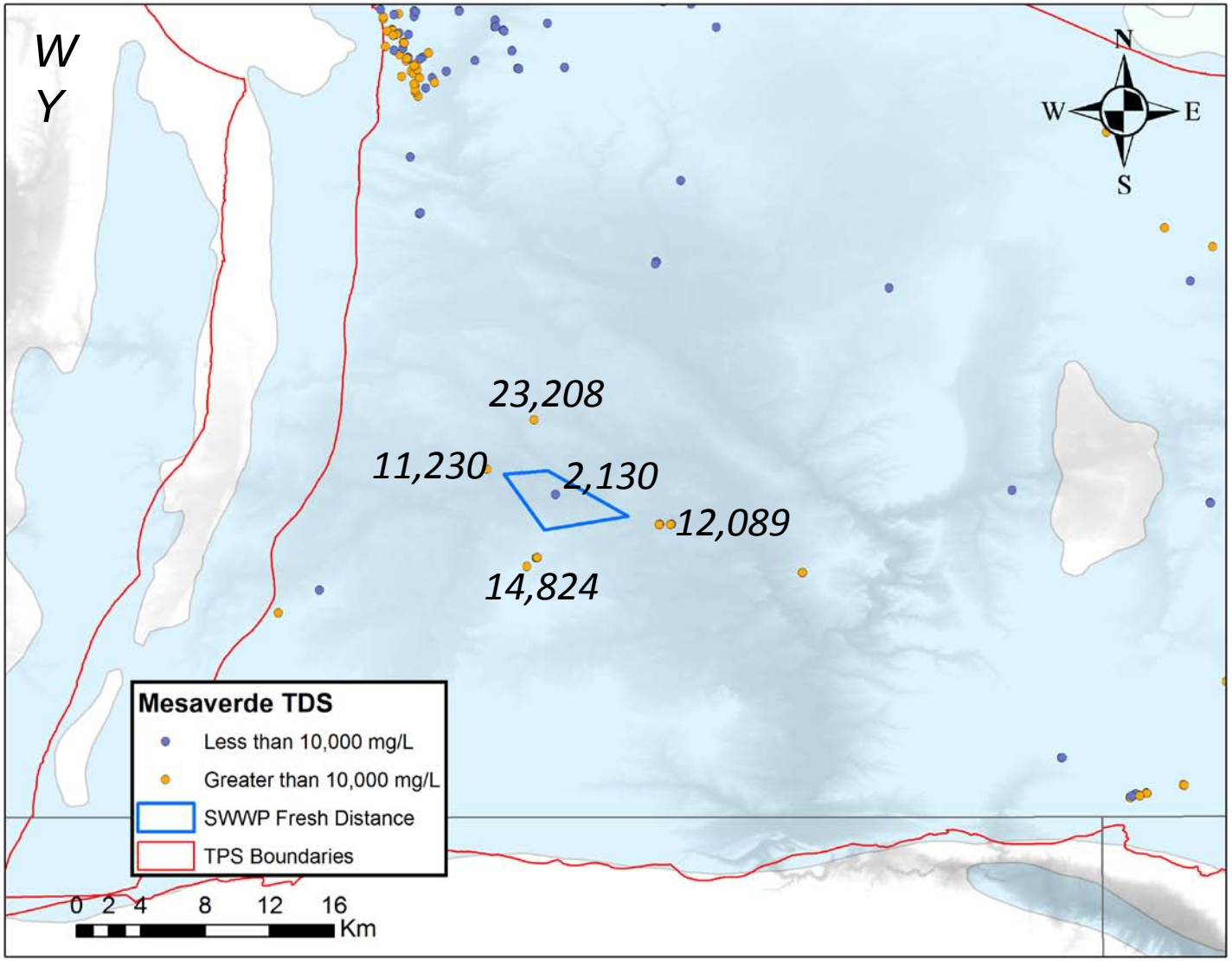

Conclusions

- *As currently defined, could the EPA regulations allow injection into drinking waters?*
- *A spatial or statistical qualifier on the Class VI injection well regulation may be useful.*
- *The broad scale, USGS approach would not work well for smaller scale projects.*
- *A detailed hydrogeologic study is likely necessary.*

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References

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